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PRESENCE-BASED SYSTEM MANAGEMENT INFORMATION ROUTING SYSTEM

BACKGROUND OF THE INVENTION

1. Technical Field:

The present invention relates generally to improved computer system management, and in particular, but not exclusively, to a system and method for routing system management information to an intended recipient based on presence awareness or the availability of the intended recipient.

2. Description of Related Art:

Management agents and/or managed resources in computer-based management systems typically send event information to system administrators in order to notify the administrators about the occurrence of critical failures or to periodically deliver summary statistics. In most of the existing management system environments, these events/notifications are typically directed to a centralized entity in the management system. The effectiveness of the management response to the event, and in particular to the critical failure information, depends to a great extent on the parties responsible for responding to the incoming event information having adequate access or connectivity to the centralized entity. However, the access or connectivity to the centralized entity needed by these responsible parties may not be available in certain situations because of computer network restrictions or client software

requirements, to name a few. Therefore, it would be advantageous to have an improved system and method for routing system management information, and in particular, but not exclusively, for routing event or notification information to those parties responsible for responding to the events or notifications involved.

SUMMARY OF THE INVENTION

The present invention provides a system, method and computer instructions for routing system management information to entities, parties or persons who are responsible for responding to the management information. If a management agent or managed resource associated with a computer-based management system desires to send event or notification information to an entity, party or person responsible for responding to the event or notification information, the management agent or managed resource can determine an identity of an entity, party or person responsible for responding to the event or notification from a prioritized "on-call list". The management agent or managed resource can then determine the availability of the identified entity, party or person from a Presence Network, and send the event or notification information to a resource where the identified entity, party or person is currently "present". The presence information obtained from the Presence Network can be used by the management agent or managed resource to determine which of the responsible entities, parties or persons are available at run-time. The management agent or managed resource can then forward the event or notification information to the most appropriate responsible entity, party or person.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 depicts a pictorial representation of a network of data processing systems in which the present invention may be implemented;

Figure 2 is a block diagram of a data processing system that may be implemented as a server in accordance with a preferred embodiment of the present invention;

Figure 3 is a block diagram of a data processing system that may be implemented as a client in accordance with a preferred embodiment of the present invention; and

Figure 4 depicts a pictorial representation of a system for routing system management information, such as event or notification information, which may be implemented in accordance with a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the figures, **Figure 1** depicts a pictorial representation of a network of data processing systems in which the present invention may be implemented. Network data processing system **100** is a network of computers in which the present invention may be implemented. Network data processing system **100** contains a network **102**, which is a medium used to provide communications links between various devices and computers connected together within network data processing system **100**. Network **102** may include certain connections, such as wire, wireless communication links, or fiber optic cables. In accordance with a preferred embodiment of the present invention, network **100** can represent and/or include "Presence Network" **103**, which is a medium used to provide presence or availability information about selected entities, parties or persons in order to ensure that certain system management information, such as, for example, event or notification information, is routed to an appropriate entity, party or person responsible for responding to the system management information involved. As such, a novel system for routing system management information (e.g., event or notification information) to a responsible entity, party or person is described below with respect to **Figure 4**.

In the depicted example, server **104** is connected to network **102**. Server **104** provides access to storage unit **106** for clients **108, 110, 112**. Server **104** can include a monitor **105** for displaying resources associated with

server **104**. In addition, clients **108**, **110**, and **112** are connected to network **102**. These clients **108**, **110**, and **112** may be, for example, personal computers or network computers. Clients **108**, **110**, **112** can include respective monitors **109**, **111**, **113** for displaying resources associated with clients **108**, **110**, **112**. In the depicted example, server **104** may provide data, such as boot files, Operating System (OS) images, and applications to clients **108**, **110**, and **112**. Clients **108**, **110** and **112** are clients with respect to server **104**. Network data processing system **100** may include additional servers, clients, and other devices not shown.

Server **104** can provide data from storage unit **106**. Data from storage unit **106** can include Web pages. The Web pages may be, for example, HyperText Markup Language (HTML) documents. For this exemplary embodiment, the Web pages can be different, dynamic Web pages with, for example, Active Server Page (ASP) code embedded therein, a Java applet associated therewith, and/or a Java Script embedded therein.

In the depicted example, network data processing system **100** can be the Internet, with network **102** representing a worldwide collection of networks and gateways that use the known Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols to communicate with one another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers, including thousands of commercial, government, educational and other computer systems that route data and messages. Of

course, network data processing system **100** also may be implemented as a number of different types of networks, such as, for example, an intranet, internal network, Local Area Network (LAN), or Wide Area Network (WAN). In this regard, **Figure 1** is intended as an example, and not as an architectural limitation for the present invention.

Referring to **Figure 2**, a block diagram of a data processing system that may be implemented as a server, such as server **104** in **Figure 1**, is depicted in accordance with a preferred embodiment of the present invention. Data processing system **200** may be a symmetric multiprocessor (SMP) system including a plurality of processors **202** and **204** connected to system bus **206**. Alternatively, data processing system **200** may be a single processor system. Also connected to system bus **206** is memory controller/cache **208**, which provides an interface to local memory **209**. I/O bus bridge **210** is connected to system bus **206** and provides an interface to I/O bus **212**. Memory controller/cache **208** and I/O bus bridge **210** may be integrated, or separately configured as depicted.

Peripheral component interconnect (PCI) bus bridge **214** connected to I/O bus **212** provides an interface to PCI local bus **216**. A number of modems may be connected to PCI local bus **216**. Typical PCI bus implementations will support four PCI expansion slots or add-in connectors. Communications links to clients **108**, **110**, **112** in **Figure 1** may be provided through modem **218** and network adapter **220** connected to PCI local bus **216** through add-in boards.

Additional PCI bus bridges **222** and **224** provide interfaces for additional PCI local buses **226** and **228**,

from which additional modems or network adapters may be supported. In this manner, data processing system **200** allows connections to multiple network computers. A memory-mapped graphics adapter **230** and hard disk **232** may also be connected to I/O bus **212** as depicted, either directly or indirectly. Data processing system **200** can include a monitor, such as, for example, monitor **105** in **Figure 1** for displaying resources of data processing system **200**.

Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 2** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

The data processing system depicted in **Figure 2** may be, for example, an IBM e-Server pSeries system, a product of International Business Machines Corporation in Armonk, New York, running the Advanced Interactive Executive (AIX) operating system or LINUX operating system.

With reference now to **Figure 3**, a block diagram of a data processing system that may be implemented as a client, such as one or more of clients **108, 110, 112** in **Figure 1**, is depicted in accordance with a preferred embodiment of the present invention. For example, data processing system **300** in **Figure 3** can be a client processing unit, computer, workstation, Personal Digital Assistant (PDA), etc. As shown, data processing system

300 can employ a PCI local bus architecture. However, although the depicted example employs a PCI bus, other bus architectures such as, for example, Accelerated Graphics Port (AGP) and Industry Standard Architecture (ISA) may be used. Processor **302** and main memory **304** are connected to PCI local bus **306** through PCI bridge **308**. PCI bridge **308** also may include an integrated memory controller and cache memory for processor **302**. Additional connections to PCI local bus **306** may be made through direct component interconnection or through add-in boards.

In the depicted example, LAN adapter **310**, Small Computer System Interface (SCSI) host bus adapter **312**, and expansion bus interface **314** are connected to PCI local bus **306** by direct component connection. In contrast, audio adapter **316**, graphics adapter **318**, and audio/video adapter **319** are connected to PCI local bus **306** by add-in boards inserted into expansion slots. Expansion bus interface **314** provides a connection for a keyboard and mouse adapter **320**, modem **322**, and additional memory **324**. SCSI host bus adapter **312** provides a connection for hard disk drive **326**, tape drive **328**, and CD-ROM drive **330**. Typical PCI local bus implementations will support three or four PCI expansion slots or add-in connectors. Data processing system **300** can include a monitor, such as, for example, one of monitors **109**, **111**, **113** in **Figure 1** for displaying resources of data processing system **300**.

An OS runs on processor **302** and is used to coordinate and provide control of various components

within data processing system **300** in **Figure 3**. The OS may be a commercially available OS, such as Windows XP or Windows 2000, which are available from Microsoft Corporation. Also, for example, an object-oriented programming system such as Java may run in conjunction with the OS and provide calls to the OS from Java programs or applications executing on data processing system **300**. "Java" is a trademark of Sun Microsystems, Inc. Instructions for the OS, the object-oriented OS, and applications or programs are located on storage devices, such as hard disk drive **326**, and may be loaded into main memory **304** for execution by processor **302**.

Those of ordinary skill in the art will appreciate that the hardware in **Figure 3** may vary depending on the implementation. Other internal hardware or peripheral devices, such as flash ROM (or equivalent nonvolatile memory) or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figure 3**. Also, the processes of the present invention may be applied to a multiprocessor data processing system.

As another example, data processing system **300** may be a stand-alone system configured to be bootable without relying on some type of network communication interface, whether or not data processing system **300** includes some type of network communication interface. As a further example, data processing system **300** may be a PDA or similar device, which is configured with ROM and/or flash ROM in order to provide non-volatile memory for storing OS files and/or user-generated data.

The depicted example in **Figure 3** and above-described examples are not meant to imply architectural limitations on the present invention. For example, data processing system **300** also may be a notebook computer or hand-held computer in addition to taking the form of a PDA. Also, data processing system **300** may be a kiosk or a Web appliance.

Figure 4 depicts a pictorial representation of a system for routing system management information, such as event or notification information, which may be implemented in accordance with a preferred embodiment of the present invention. For this exemplary embodiment, system **400** includes responsible entity **402**. Entity **402** represents an entity, party or person having the responsibility of responding to the system management information received. For example, an entity responsible for responding to the system management information may be automated or human. The system management information can be conveyed in message or report form and include text, voice or video information related, for example, to the occurrence of an event (e.g., critical failure of a system component), notification information related to an event, and/or system administrative information. In other words, the present invention enhances the routing of the system management information to ensure that the system management information effectively reaches an intended recipient, such as an entity, party or person having responsibility for responding to the system management information.

Entity **402** is associated with notification handlers **404, 406**. For this exemplary embodiment, notification handler **404** is preferably an Instant Messaging client (e.g., software application) running on workstation **408** and associated with entity **402**. Notification handler **404** and workstation **408** can be implemented, for example, by client **108, 110** or **112** in **Figure 1**. Notification handler **406** is preferably an Instant Messaging client running on PDA **410**. Notification handler **406** can also be implemented on a server (e.g., server **104** in **Figure 1**) connected, for example, via a wireless network to PDA **410**. As such, the content of the event or notification information message or report received by notification handler **404** and workstation **408** can be in text, video and/or digitized audio form. The content of the event or notification message or report received by notification handler **406** and PDA **410** is typically in text form (e.g., limited in this regard by the processing capability of PDA **410**).

Although not shown explicitly in **Figure 4**, entity **402** can also include other notification handlers associated with other types of telecommunication media for receiving and responding to the system management information involved, such as, for example, cellular phones (e.g., using the Wireless Application Protocol or WAP to convey textual or digitized audio information), satellite communication radiotelephones, etc. In any event, a notification handler (e.g., notification handler **404, 406**) can receive system management information via an Instant Message, and if necessary, convert the system

management information received in Instant Message form to a form that is appropriate for the resource (e.g., workstation, PDA, cellular telephone, radiotelephone, notebook computer, hand-held computer, etc.) that provides "presence" or availability information about the intended recipient or entity. For illustrative purposes, notification handler **412** is also shown in order to indicate that additional entities, parties or persons responsible for responding to system management information may also be intended recipients for such information. For example, notification handler **412** can function as a default responsible entity, which provides a "canned" response to received system management information. In this regard, the depicted examples of notification handlers and entities/resources in **Figure 4** are not meant to imply architectural limitations on the present invention.

Notification handlers **404**, **406** and **412** are connected to Presence Network **430**. For this embodiment, Presence Network **430** preferably includes an Instant Messaging network that provides network "presence" information and Instant Messaging services, such as, for example, Yahoo's Instant Messaging services or Microsoft Network's (MSN's) Instant Messaging services. Presence Network **430** can operate in accordance with known "presence" and instant messaging protocols, such as, for example, the Session Initiation Protocol (SIP), the SIP for Instant Messaging and Presence Leverage Extensions (SIMPLE), and the XML-based Extensible Messaging and Presence Protocol (XMPP). Presence Network **430** can also derive network "presence"

or availability information using, for example, the Hotsip Presence Engine produced by Hotsip AB at Stockholm, Sweden. The Hotsip Presence Engine is a SIP/SIMPLE-based back-end server system that can aggregate real-time presence information such as a person's availability, terminal status, location, current activity and mood. A server collects presence information from different SIP clients and other systems. The aggregated information is then provided for presence, messaging, voice and video services. The Hotsip Presence Engine can run on J2EE and with LINUX and AIX OS's.

As illustrated in **Figure 1**, Presence Network **430** functions as an overlay over the underlying network(s) (e.g., network **102** in **Figure 1**) that provide connectivity for routing system management information to the appropriate notification handler and entity/resource involved. Also, Presence Network **430** provides "presence" information (e.g., "presence" and/or availability of one or more of the entities, parties or persons associated with notification handlers **404**, **406**, **412**) for use by one or more of management agent **416** and managed resources **418**, **420** of management unit **414**, and managed resources **424**, **426** of management unit **422**. For example, management agent **416** can include a management service application that monitors or manages a managed resource (e.g., managed resources **418**, **420**). Therefore, management agent **416** can derive system management information (e.g., critical failure, notification information, etc.) from one or both of managed resources **418**, **420**. Also, each managed resource (e.g., each of managed resources **418**,

420, **424**, **426**) can generate system management information independently of management agent **416**. Each managed resource **418**, **420**, **424**, **426** can be, for example, an OS (e.g., Linux, AIX, etc.), J2EE container, or similar network software or hardware resource.

Management agent **416** and each of managed resources **424**, **426** are connected to handler call list **428**. For this embodiment, handler call list **428** is preferably an "on-call list" that resides in a database or similar data storage location (e.g., storage unit **106** in **Figure 1**). The "on-call list" includes identification information for each of the entities, parties or persons responsible for responding to the system management information derived or generated by management agent **416** and managed resources **418**, **420**, **424**, **426**. The "on-call list" may be static (e.g., a file or property list) or dynamic (e.g., a result of a database query or directory lookup).

When management agent **416** or one of managed resources **418**, **420**, **424**, **426** desires to send out a message or report related to an event or notification, the management agent or managed resource consults the "on-call list" (e.g., handler call list **428**) and retrieves the stored identification information including an address for the respective notification handler(s) associated with the retrieved identity information. The management agent or managed resource then determines from Presence Network **430** the "presence" or availability of the resource (e.g., workstation **408**, PDA **410**) associated with the responsible entity, party or person intended as a recipient of the event or notification information.

The management agent or managed resource then forwards the event or notification message or report to the appropriate notification handler(s) associated with the intended recipient(s) of the event or notification information via an Instant Message. The payload of the Instant Message may be tailored to the format of the intended recipient's resource (e.g., workstation, PDA, cellular phone, etc.) that is providing the "presence" for the selected entity, party or person involved. As illustrated in **Figure 4**, Presence Network **430** can determine that workstation **408** is unavailable to receive the system management information, and PDA **410** is available. Thus, the management agent or managed resource can forward the event or notification message or report to the intended recipient via PDA **410**.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media, such as a floppy disk, a hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and transmission-type media, such as digital and analog communications links, wired or wireless communications links using transmission forms, such as, for example,

radio frequency and light wave transmissions. The computer readable media may take the form of coded formats that are decoded for actual use in a particular data processing system.

The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.